# Technical Information Manual

Revision n. 6
9 March 2009

**MOD. A 1735 - A 1835**
**A 1735B - A 1835B**
*12/28 CHANNEL*
*HV BOARDS*
**MANUAL REV.6**

**NPO:**
**00101/00:17XXx.MUTx/06**

CAEN will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

**CAEN declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly the CAEN User's Manual before any kind of operation.**

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*CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.*

## Disposal of the Product

*The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.*

# *TABLE OF CONTENTS*

**1. INTRODUCTION ..... 4**

1.1 THE CAEN UNIVERSAL MULTICHANNEL POWER SUPPLY SYSTEM ..... 4

1.2 TECHNICAL SPECIFICATIONS TABLE OF THE SY 1527 SYSTEM ..... 6

**2. MOD. A 1735 - A 1835 HV BOARDS ..... 7**

2.1 FUNCTIONAL DESCRIPTION ..... 7

2.2 CHANNEL CHARACTERISTICS TABLE ..... 8

2.3 FRONT PANEL ..... 9

2.4 TECHNICAL SPECIFICATIONS ..... 10

*2.4.1 Packaging ..... 10*

*2.4.2 External connections ..... 10*

*2.4.3 Displays ..... 11*

*2.4.4 Other components ..... 11*

**3. SAFETY INFORMATION AND INSTALLATION REQUIREMENTS ..... 12**

3.1 GENERAL SAFETY INFORMATION ..... 12

*3.1.1 Injury Precautions ..... 12*

3.2 SAFETY TERMS AND SYMBOLS ON THE PRODUCT ..... 12

3.3 INSTALLATION ..... 13

**4. OPERATING MODES ..... 14**

4.1 OUTPUT CONTROL AND MONITORING ..... 14

4.2 OUTPUT ENABLE ..... 15

4.3 FULL SCALE RANGE SETTING ..... 15

# LIST OF FIGURES

FIG. 2.1 – MOD. A 1735 – A 1835 (LEFT) AND MOD. A 1735B – A 1835B (RIGHT) FRONT PANEL .....9
FIG. 2.2 – MOD. A 1735B – A 1835B HV MULTIPIN CONNECTOR .....11
FIG. 4.1 – A) MOD. A1735 - A 1835 SIDE VIEW; B) MOD. A1735B - A 1835B TOP VIEW .....16
FIG. 4.2 – FULL SCALE RANGE DIP-SWITCH TOP VIEW .....17

# LIST OF TABLES

TABLE 1.1 - TECHNICAL SPECIFICATIONS OF THE SY 1527 MAINFRAME: GENERAL .....6
TABLE 2.1 - CHANNEL CHARACTERISTICS OF THE MOD. A 1735 / 1735B - A 1835 / 1835B HV BOARDS .....8
TABLE 4.1 - FULL SCALE RANGE SETTINGS .....16

# 1. Introduction

## 1.1 The CAEN Universal Multichannel Power Supply System

The SY 1527 system is the fully equipped, large scale experiment version of a new line of power supply systems which represent CAEN's latest proposal in the matter of High Voltage and Low Voltage Power Supplying. This system outlines a completely new approach to power generation and distribution by allowing to house, in the same mainframe, a wide range of boards with different functions, such as High/Low Voltage boards, generic I/O boards (temperature, pressure monitors, etc.) and branch controllers, where the latter are used to control other remote generators and distributors.

Modularity, flexibility and reliability are the key-points of its design, enabling this module to meet the requirements of a wide range of experimental conditions. The latter range from those of LHC experiments, in which the model's features find prior application, to those of other less challenging, but still demanding, High Energy Physics experiments.

The mainframe is housed in a 19"-wide, 8U-high euro-mechanics rack and hosts four main sections:

the *Board Section*, with 16 slots to house boards, distributors and branch controllers;

the *Fan Tray Section*, housing 6 fans disposed on two rows;

the *Power Supply Section*, which consists of the primary power supply and up to 3 power supply units;

the *CPU and Front Panel Section* which includes all interface facilities.

The User interface features the usual friendliness of the previous CAEN systems which now also includes a 7.7" colour LCD. A wide choice of interfaces provides full communication compatibility with the previous systems and the possibility of controlling heterogeneous external devices.

Modularity has been one of the leading criteria in the design and development of the system: both the *Power Supply Section* and the *Board Section* are completely modular. The *Power Supply Section* allows different configurations with up to 3 power supply units per mainframe (up to 2250 W), while the *Board Section* can house up to 16 boards able to fulfil different functions. A new line of boards and distributors, analogous with those available for the SY 527 system, and a set of branch controllers has been specially developed for this new system. The minimum system configuration consists of the primary power supply, one Power Supply Unit and one board.
The concept of modularity has been extended up to the possibility of arranging "clusters", consituted by one "intelligent" SY 1527 system able to drive other "non-intelligent" systems, i.e. systems without CPU (to be implemented). The connections among the systems constituting the cluster are realised through a new CAEN interface, the Local Net.

The extreme flexibility of the system, which allows to house indifferently, inside the same mainframe, boards with different functions, is further enhanced by the possibility of developing *ad-hoc* boards and even complete custom peripheral systems. The latter,

actually, can be designed specifically for on-detector installation. All the custom electronics can be anyway remotely controlled by single boards which are inserted in the SY 1527 mainframe and act as branch controllers.

Fast, accurate set-up and monitoring of system parameters (14-bit resolution on Voltages and Currents with standard boards) is available for each branch controller thanks to the use of one microprocessor per slot. All the operational parameters are stored in a non-volatile memory (EEPROM) to be still available after Power-Off. The parameters can be controlled either via CAEN traditional built-in links (RS232, H.S. CAENET) or via CERN-approved Fieldbuses or via Ethernet (TCP/IP). Programmable handling of parameters and errors is available as well.

Channel trip control on other crates is performed via four external differential trip lines. A sophisticated trip handling via software allows to control and correlate trip conditions on the channels of the crate as well as of other crates connected to it.

Live insertion and extraction of the boards, which reduces the global down time, and easy access to the computing core and peripherals completes the system's flexibility.

Easy interfacing is another key-point of the SY 1527 system. Thanks to the H.S. CAENET interface, the system ensures full communication compatibility with the previous models. Besides the RS232 interface and Ethernet (TCP/IP) provided with the standard version of the system, CAN-bus can be furnished on request, as well as special boards featuring optical links for remote communications. The Power Supply Section and Board Section can be externally synchronised via front panel connectors.

Secure access to the system via Intranet is foreseen together with a multilevel management of custom User's profiles. In particular, three different access levels have been implemented: *Guest*, *User* and *Administrator*, each of which with password protection.

Handy maintenance and upgrading, which constitute a major issue in the reliability of a system, are further guaranteed by the possibility of accessing and servicing the system via network facilities. Actually, Telnet and WWW access facilities allow remote debugging and technical support of the system, including future firmware upgrading.

For a detailed description of the SY 1527 Universal Multichannel Power Supply System please refer to the *SY 1527 User's Manual* .

## 1.2 Technical Specifications Table of the SY 1527 system

**Table 1.1 - Technical specifications of the SY 1527 mainframe: general**

| | |
|---|---|
| **Packaging** | - 19"-wide, 8U-high Euro-mechanics rack;<br>- Depth: 720 mm. |
| **Weight** | -Mainframe (*): 24 kg<br>-Mod. A1532: 3.2 kg |
| **Power requirements** | *Voltage range*: 100/230 V<br>*Frequency*: 50/60 Hz<br>*Power*: 3400 W |
| **Max. number of boards per crate** | 16 |
| **Max. number of power supply units per crate** | 3 |
| **Primary power supply output (Mod. A 1531)** | ± 12 V, 8 A<br>+5 V, 20 A |
| **Power supply unit output (Mod. A 1532)** | +48 V, 15.6 A |
| **Max. output power** | 2250 W |
| **Operating temperature** | From 0°C (dry atmosphere) to +40°C |
| **Storage temperature** | From -20°C (dry atmosphere) to +50°C |

*(*) One Primary Power Supply (Mod. A 1531) and one Power Supply Unit (Mod. A 1532) are included; boards are not included.*

# 2. Mod. A 1735 - A 1835 HV Boards

## 2.1 Functional description

The Mod. A 1735 – A 1835 are single width boards housing 12 HV channels with either positive (A 1735P – A 1835P) or negative (A 1735N – A 1835N) polarity.
28 channel double width versions (Mod. A 1735B – A 1835B) have either positive (A 1735BP – A 1835BP) or negative polarity (A 1735BN – A 1835BN)[1].
The Mod. A 1735 - A 1735B output channels have 1.5 kV / 7 mA full scale range (dip-switch selectable); the Mod. A 1835 - A 1835B output channels offer either 1.5 kV / 7 mA or 1.5 kV / 200 µA full scale range (dip-switch selectable).
If the output voltage differs from the programmed value by more than 3% of voltage full scale range, the channel is signalled to be either in OVERVOLTAGE or UNDERVOLTAGE condition. Moreover, for each channel, a voltage protection limit SVMAX can be fixed via software with 1 V resolution and the output voltage can not be programmed beyond this value.
The HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷ 500 V/s in 1 V/s steps.
The output current is monitored with 20 nA / 500 nA resolution depending on current range; if a channel tries to draw a current larger than its programmed limit it is signalled to be in OVERCURRENT condition; the SY 1527 system detects this state as a fault and reacts according to the setting of the TRIP parameter[2], namely:

TRIP=infinite ( = 1000 s)

When the set output current value is reached the channel behaves like a constant current generator.

2) TRIP=finite (< 1000 s)

The output current keeps the set value only for programmed time interval and then is switched off.

The TRIP time (i.e. the maximum time an OVERCURRENT condition is allowed to last) can be programmed in 0.1 s steps.
The maximum output voltage (VMAX Hardware) can be fixed, through a potentiometer located on the front panel, at the same common value for all the board channels and this value can be read out via software.
The boards host also a temperature sensor located on the PCB near the HV channels: the temperature values measured by this sensor are used to signal Over Temperature condition on the SY 1527.
The boards are provided with an "HV EN" input that disables the channels when it is not connected to ground.

[1] A 1735B – A 1835B are currently out of stock and no longer produced

[2] Refer to the SY1527/SY2527/SY3527 User's Manuals for details about the TRIP Handling.

## 2.2 Channel Characteristics Table

**Table 2.1 - Channel characteristics of the Mod. A 1735 / 1735B - A 1835 / 1835B HV Boards**

| | |
|---|---|
| **Polarity:** | Positive / Negative depending on purchased version |
| **Output Voltage:** | 0÷1.5 kV |
| **Max. Output Current:** | low range 200 μA (Mod. A 1835 - A 1835B)<br>high range 7 mA |
| **Voltage Set/Monitor Resolution:** | 100 mV |
| **Current Set/Monitor Resolution:** | 500 nA (Mod. A 1735 - A 1735B)<br>20 nA / 500 nA depending on current range (Mod. A 1835 – A 1835B) |
| **VMAX hardware:** | 0÷1.5 kV common for all the board channels |
| **VMAX hardware accuracy:** | ± 2% of FSR |
| **VMAX software:** | 0÷1.5 kV settable for each channel |
| **VMAX software resolution:** | 1 V |
| **Ramp Down:** | 1÷500 Volt/sec, 1 Volt/sec step |
| **Ramp Up:** | 1÷500 Volt/sec, 1 Volt/sec step |
| **Voltage Ripple:** [3] | < 30 mV pp |
| **Voltage Monitor vs. Output Voltage Accuracy:** [4] | ± 0.2 V ± 0.3% of reading |
| **Voltage Set vs. Voltage Monitor Accuracy:** [2] | ± 0.1 V ± 0.3% of setting |
| **Current Monitor vs. Output Current Accuracy:** [2] | ± 2 μA ± 2% of reading (7 mA range)<br>± 0.1 μA ± 2% of reading (200 μA range, Mod. A 1835 - A 1835B) |
| **Current Set vs. Current Monitor Accuracy:** [2] | ± 0.5 μA ± 2% of setting (7 mA range)<br>± 0.02 μA ± 2% of setting (200 μA range, Mod. A 1835 - A 1835B) |

[3] From 10 Hz to 15 MHz at full load

[4] From 10% to 90% of Full Scale Range

## 2.3 Front Panel

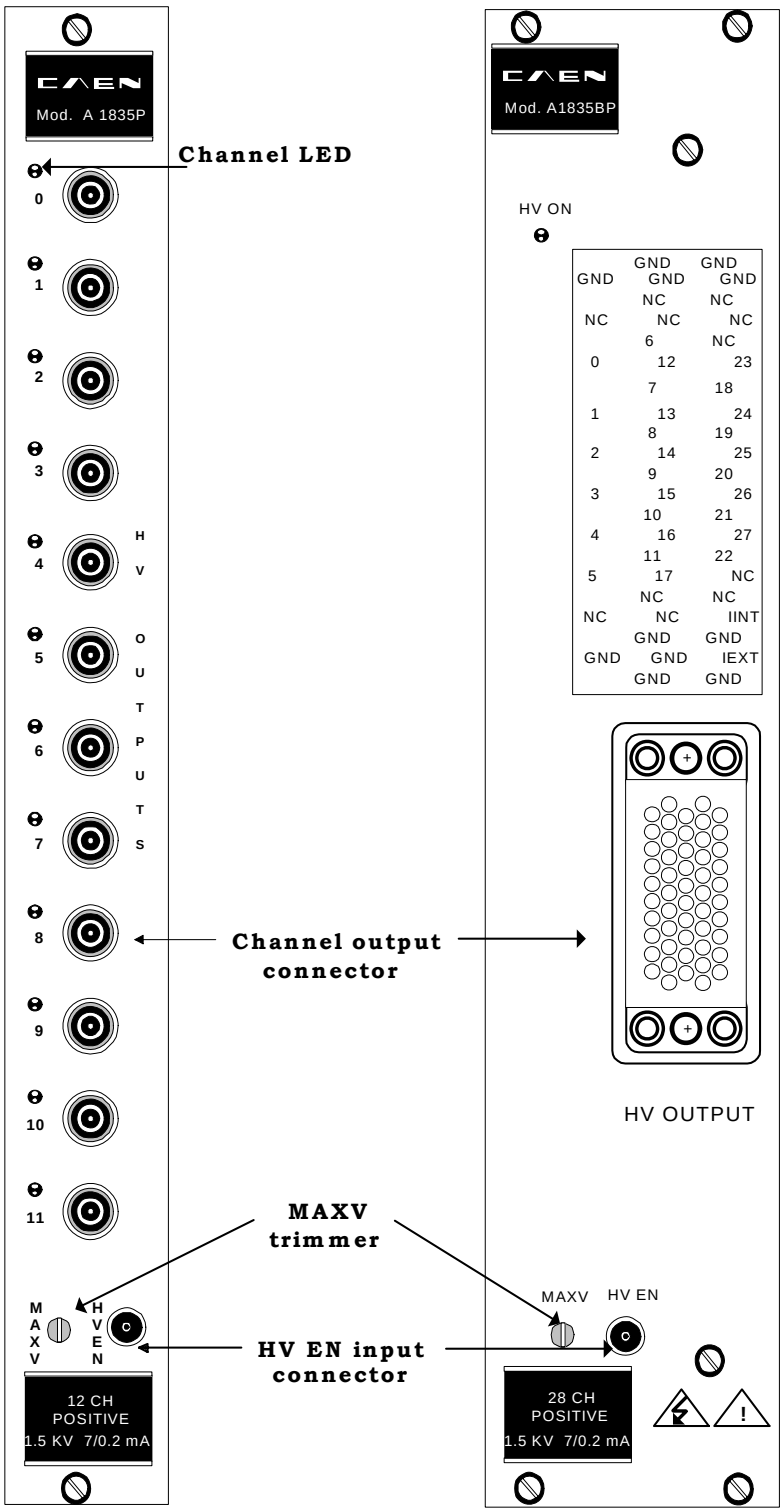


**Fig. 2.1 – Mod. A 1735 – A 1835 (LEFT) and Mod. A 1735B – A 1835B (RIGHT) front panel**

# 2.4 Technical Specifications

## *2.4.1 Packaging*

The Mod. A 1735 – A 1835 modules are housed in a 5 TE-wide, 6U-high mechanics. The Mod. A 1735B – A 1835B modules are housed in a 10 TE-wide, 6U-high mechanics.

## *2.4.2 External connections*

The location of all components of the front panel is shown in Fig. 2.1, p. 8. The function and electro-mechanical specifications of the external connectors are listed in the following subsections.

| | |
|---|---|
| **CH 0..11 (A 1735 – A 1835):** | Mechanical specifications:<br>HV coaxial connectors<br>Radiall SHVR317580-type<br>*Electrical specifications*: high voltage output according to specifications given in Table 2.1, p.8. |
| **CH 0..27 (A 1735B – A 1835B):** | Mechanical specifications:<br>Multipin connector Radiall 691803004-type, 52 pin male (to be mated with Radiall 691802002-type[5] [*SCEM 09.41.34.700.2*]); see Fig. 2.2 for pin assignment.<br>*Electrical specifications*: high voltage output according to specifications given in Table 2.1, p.8. |
| **HV EN CONNECTOR** | Mechanical specifications:<br>00-type LEMO connector.<br>*Electrical specifications:* board ENABLE input, if connected to ground, the channels are enabled. Refer to § 4.2, p.15 for further details. |

[5] Requires 52 pins Radiall 691804300 [*SCEM 09.41.33.830.7*] type, to be installed using the insertion/extraction tool Radiall 282549024 [*SCEM 34.95.17.125.3*] type.

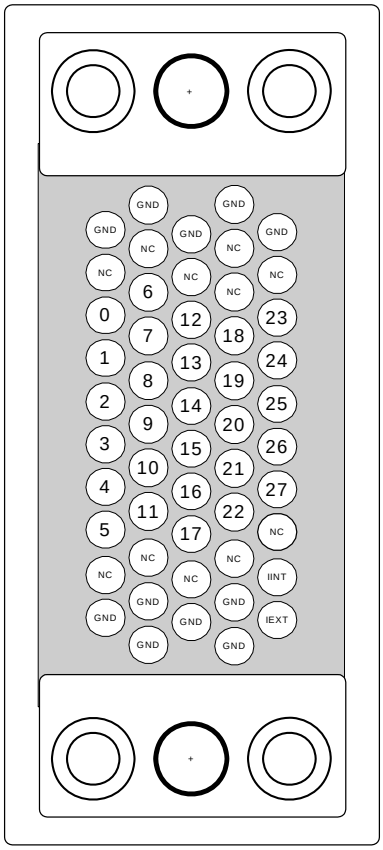


**Fig. 2.2 – Mod. A 1735B – A 1835B HV Multipin Connector**

## 2.4.3 Displays

**CH ON 0..11 LEDs (A 1735 - A1835):**

*Function:* they light up as the relevant channel is on.

*Type:* red LEDs for positive polarity version; yellow LEDs for negative polarity version

**HV ON LED (A 1735B - A1835B):**

*Function:* it lights up if at least one output channel is on.

*Type:* red LED for positive polarity version; yellow LED for negative polarity version

## 2.4.4 Other components

**VMAX trimmer:**

*Function:* it allows to adjust the hardware maximum voltage VMAX common to all the channels. Its value can be read out via software.

# 3. Safety information and installation requirements

## 3.1 General safety information

This section contains the fundamental safety rules for the installation and operation of the boards. Read thoroughly this section before starting any procedure of installation or operation of the product.

### *3.1.1 Injury Precautions*

Review the following precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.

**Avoid Electric Overload.**
To avoid electric shock or fire hazard, do not apply a voltage to a load that is outside the range specified for that load.

**Avoid Electric Shock.**
To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

**Do Not Operate Without Covers.**
To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

**Do Not Operate in Wet/Damp Conditions.**
To avoid electric shock, do not operate this product in wet or damp conditions.

**Do Not Operate in an Explosive Atmosphere.**
To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

**Do Not Operate With Suspected Failures.**
If you suspect there is damage to this product, have it inspected by qualified service personnel.

## 3.2 Safety Terms and Symbols on the Product

These terms may appear on the product:

- **DANGER** indicates an injury hazard immediately accessible as you read the marking.
- **WARNING** indicates an injury hazard not immediately accessible as you read the marking.

- **CAUTION** indicates a hazard to property including the product.

The following symbols may appear on the product:

**DANGER**

**High Voltage**

**ATTENTION**

**Refer to Manual**

## 3.3 Installation

The Mod. A 1735 – A 1835 are single-width boards which can be inserted in any slot of the SY 1527 crate. The Mod. A 1735B – A 1835B are double-width boards which occupy two SY 1527 slots each. At power ON the SY 1527 system processor will scan all the slots in the crate to find out where the module is plugged and what kind of module it is.

# 4. Operating modes

The Mod. A 1735 – A 1835 and A 1735B – A 1835B boards can be controlled, either locally or remotely, through the SY 1527 software interface. For details on SY 1527 system operation, please refer to the User's Manual of this product. The following sections contain a description of commands available for the board control and status monitoring.

**ATTENTION**

**THE MOD. A 1735 and A 1835 BOARDS REQUIRE**

**SY 1527 FIRMWARE VERSION 1.09.04 OR LATER**

## 4.1 Output control and monitoring

For each output channel, it is possible, through the SY 1527 system, to perform the following operations:

- Assign to channel a symbolic name
- Set output voltage (VSET)
- Set max. output current (ISET)
- Set output voltage software limit (SVMAX)
- Set voltage ramp-up speed (RAMP-UP)
- Set voltage ramp-down speed (RAMP-DOWN)
- Set TRIP parameter
- Enable/disable POWER ON option
- Switch channel ON/OFF
- Monitor output voltage (VMON)
- Monitor output current (IMON)
- Monitor channel status

If the POWER ON option is enabled, the channel, at POWER ON, is restored in the same condition it was before the POWER OFF or RESET; if this option is disabled, at POWER ON or after a RESET, the channel is kept OFF independently from its previous condition.

The following messages may be returned by the SY 1527 when monitoring the channel status:

- OFF (channel turned OFF)
- RUP (channel ramping up)

- RDWN (channel ramping down)
- OVC (channel in OVERCURRENT condition)
- OVV (channel in OVERVOLTAGE condition)
- UNV (channel in UNDERVOLTAGE condition)
- EXTTRIP (channel OFF due to external TRIP line signal)
- INTTRIP (channel OFF due to internal OVERCURRENT condition)
- EXT_DIS (channel disabled by board INTERLOCK protection)

Moreover it is possible to monitor board temperature and to check board status; the following messages may be returned by the SY 1527 when monitoring the board status:

- UNDER_TEMP (board temperature < 5°C )
- OVER_TEMP (board temperature > 65°C)

## 4.2 Output Enable

The following procedures must be performed in order to enable the board's operation:

- Provide the "HV EN" connector with a 50 Ohm termination.

- Provide short circuit between Pin 51 and Pin 52 (IINT and IEXT) of the HV Multipin Connector (see Fig. 2.2); this is a safety feature to verify that the connector is plugged and the channels are connected to their loads (see § 2.4.2). This operation is not necessary if the S1 pins on the PCB are short circuited.

Such procedures are unnecessary if the S2 pins on the PCB are short circuited.

S1 and S2 are placed on the PCB's lower edge, just behind the front panel.

When the channels are disabled the voltage outputs drop to zero at the maximum rate available; when the output disable cause is removed, the channels remain OFF until the User turns them ON via software.

## 4.3 Full scale range setting

The output voltage and current full scale range, common to all channels, can be selected by dip-switches (please refer to the Fig. 4.1 for the dip-switches location on the board).

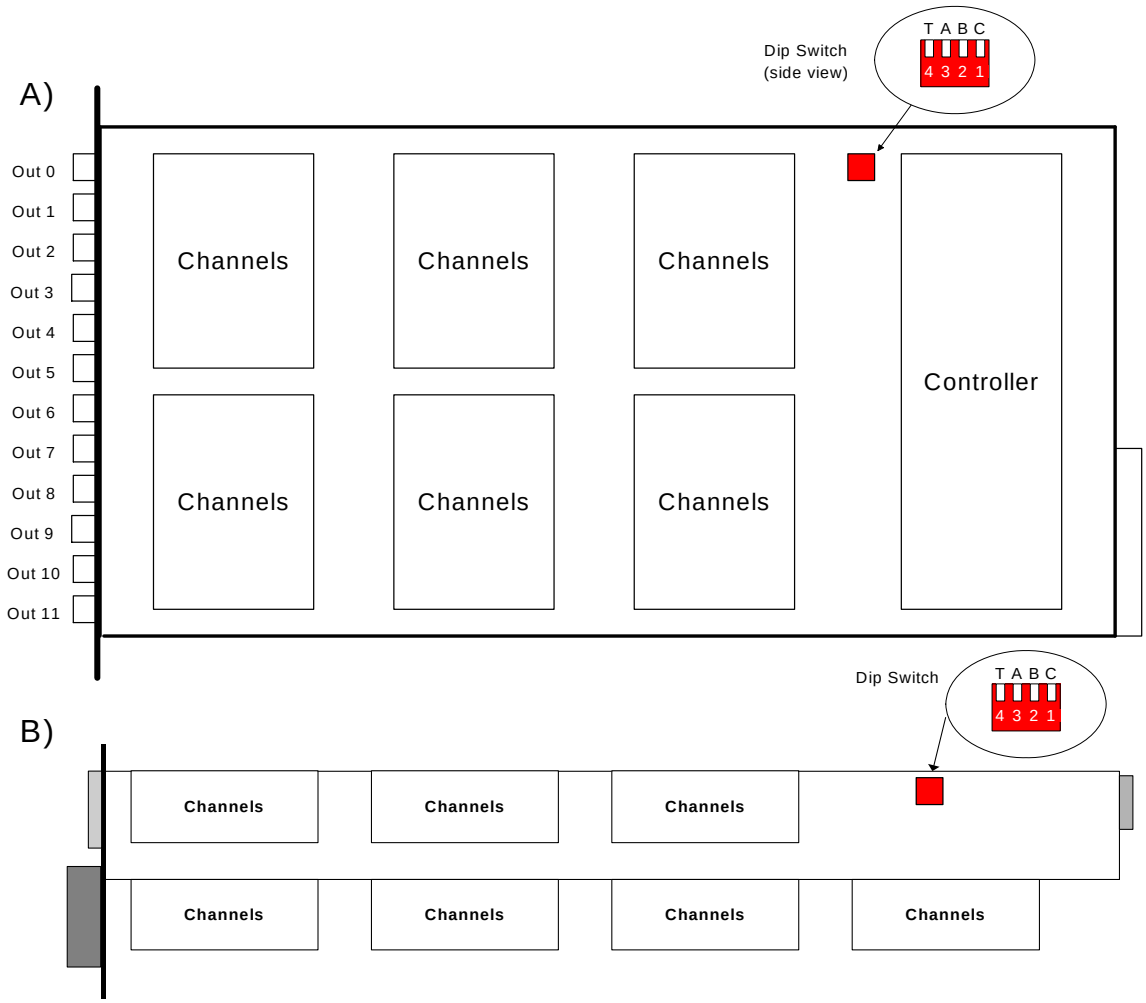


**Fig. 4.1 – A) Mod. A1735 - A 1835 side view; B) Mod. A1735B - A 1835B top view**

In order to select the desired Full Scale Range (FSR) the dip-switches must be set as illustrated in the following table (refer also to Fig. 4.3).

| Dip-switch 1 | Dip-switch 2 | Voltage FSR | Current FSR |
|---|---|---|---|
| OFF | ON | 1.5 kV | 7 mA |
| OFF | OFF | 1.5 kV | 200 μA |

**Table 4.1 - Full scale range settings**

Full scale range selection must be performed before inserting the board into the crate.

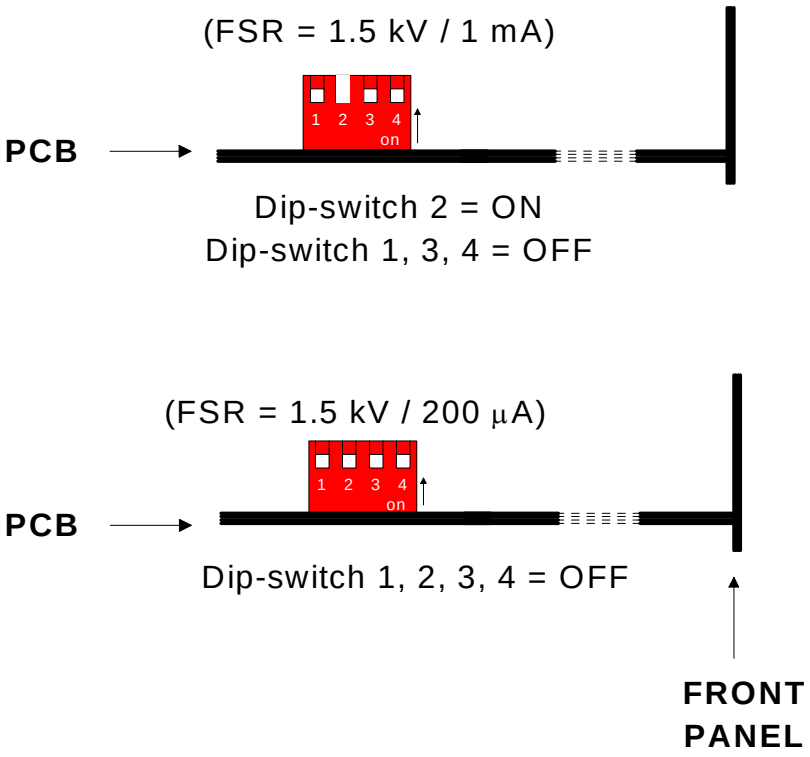


**Fig. 4.2 – Full scale range dip-switch top view**